WAVELET AND FRACTAL ANALYSIS OF REMOTELY SENSED SURFACE TEMPERATURE WITH APPLICATIONS TO ESTIMATION OF SURFACE SENSIBLE HEAT FLUX DENSITY

John Schieldge, California Institute of Technology, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109-8099

Wavelet and fractal analyses have been used successfully to analyze one-dimensional data sets such as time series of financial, physical, and biological parameters. These techniques have been applied to two-dimensional problems in some instances, including the analysis of **remote sensing** imagery. In this respect, these techniques have not been widely used by the remote sensing community, and their overall capabilities as analytical tools for use on satellite and aircraft data sets is not well known. Wavelet and fractal analyses have the potential to provide fresh insight into the characterization of surface properties such as **temperature** and emissivity distributions, and surface processes such as the heat and water vapor exchange between the surface and the lower atmosphere. In particular, the variation of sensible heat flux density as a function of the change in scale of surface properties is difficult to estimate, but - in general - wavelets and fractals have proved useful in determining the way a parameter varies with changes in scale.

We present the results of a limited study on the relationship between spatial variations in surface temperature distribution and sensible heat flux distribution as determined by separate wavelet and fractal analyses. We analyzed aircraft imagery obtained in the thermal infrared (IR) bands from the multispectral TIMS and hyperspectral MASTER airborne sensors. The thermal IR data allows us to estimate the surface kinetic temperature distribution for a number of sites in the Midwestern and Southwestern United States (viz., San Pedro River Basin, Arizona; El Reno, Oklahoma; Jornada, New Mexico). The ground spatial resolution of the aircraft data varied from 5 to 15 meters. All sites were instrumented with meteorological and hydrological equipment including surface layer flux measuring stations such as Bowen Ratio systems and sonic anemometers. The ground and aircraft data sets provided the inputs for the wavelet and fractal analyses, and the validation of the results.